



EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
28.12.2022 Bulletin 2022/52

(51) International Patent Classification (IPC):
H04W 48/18 ^(2009.01) **H04W 88/10** ^(2009.01)
H04W 16/14 ^(2009.01) **H04W 92/04** ^(2009.01)

(21) Application number: **17814473.9**

(52) Cooperative Patent Classification (CPC):
H04W 88/10; H04W 48/18; H04W 76/11;
H04W 92/045; H04W 88/16; H04W 92/06;
H04W 92/12; H04W 92/24

(22) Date of filing: **10.04.2017**

(86) International application number:
PCT/CN2017/079933

(87) International publication number:
WO 2017/219734 (28.12.2017 Gazette 2017/52)

(54) **S1AP SIGNALING TRANSMISSION METHOD AND APPARATUS**

VERFAHREN UND VORRICHTUNG ZUR ÜBERTRAGUNG VON S1AP-SIGNALIERUNG

PROCÉDÉ ET APPAREIL DE TRANSMISSION DE SIGNALISATION S1AP

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

(30) Priority: **22.06.2016 CN 201610461474**

(43) Date of publication of application:
01.05.2019 Bulletin 2019/18

(73) Proprietor: **Datang Mobile Communications
Equipment Co., Ltd.**
Beijing 100083 (CN)

(72) Inventors:

- **DUAN, Jianghai**
Beijing 100083 (CN)
- **ZHENG, Zhenduo**
Beijing 100083 (CN)
- **HE, Ke**
Beijing 100083 (CN)
- **DING, Guodong**
Beijing 100083 (CN)
- **SU, Lifang**
Beijing 100083 (CN)
- **ZHANG, Zhengkun**
Beijing 100083 (CN)
- **CHEN, Jie**
Beijing 100083 (CN)

- **WU, Fanyu**
Beijing 100083 (CN)
- **XI, Jiande**
Beijing 100083 (CN)
- **WANG, Gaoliang**
Beijing 100083 (CN)
- **ZHANG, Haibo**
Beijing 100083 (CN)

(74) Representative: **Bals & Vogel Patentanwälte
PartGmbB**
Konrad-Zuse-Str. 4
44801 Bochum (DE)

(56) References cited:

WO-A1-2015/061978 CN-A- 102 300 284
CN-A- 104 469 862 CN-A- 105 188 108
US-A1- 2014 018 083

- **3GPP: "3rd Generation Partnership
Project; Technical Specification Group Radio
Access Network; Home (e)NodeB; Network
aspects (Release 8)", 3GPP DRAFT;
R3-083410_R3.020_V092_CLEAN_V2, 3RD
GENERATION PARTNERSHIP PROJECT (3GPP),
MOBILE COMPETENCE CENTRE ; 650, ROUTE
DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS
CEDEX ; FRANCE, no. Prague, Czech Republic;
20081117, 17 November 2008 (2008-11-17),
XP050324621, [retrieved on 2008-11-17]**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

- "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture description (Release 13)", 3GPP STANDARD; 3GPP TS 36.401, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG3, no. V13.1.0, 19 March 2016 (2016-03-19), pages 1-21, XP051088295, [retrieved on 2016-03-19]
- "3 Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (Release 12)", 3GPP STANDARD ; TECHNICAL SPECIFICATION ; 3GPP TS 36.413, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG3, no. V12.7.0, 19 March 2016 (2016-03-19), pages 1-302, XP051295141, [retrieved on 2016-03-19]

Description**Field**

- 5 **[0001]** The present invention relates to the field of communications, and particularly to a method and apparatus for transmitting S1AP signaling.

Background

- 10 **[0002]** As the mobile wideband technologies are advancing dramatically, the amount of data traffic is growing significantly, and there is also an increasing amount of data in various indoor and outdoor hotspot scenarios. A traditional macro cell suffers from a bottleneck of network deployment and coverage, and in order to provide deep network coverage and to improve the capacity of the network while considering a cost factor, operators pay more attention to a small cell.

- 15 **[0003]** Fig. 1 illustrates a network architecture of small cells in the prior art, where the small cells access a transmission network, and are connected with a core network, after being aggregated by a switch. The core network includes a Security Gateway (Se-GW), a signaling gateway (He-NB Gateway (He-GW)), an Evolved Packet Core (EPC), and other devices. A Mobile-Edge Computing (MEC) server is connected in series between the small cells and the core network, and accesses local traffic using a Traffic Offload Function (TOF) function.

- 20 **[0004]** However in a real application, the small cells are assets of the operators, operate in licensed frequency bands of their operators, and are generally deployed in indoor scenarios, e.g., a supermarket, a museum, an airport, etc. There are certainly users of a plurality of operators in various application scenarios, and in order to provide the users of all the operators with a network service, the different operators set up their own networks respectively and provide their respective users with a network service respectively in a small cell based user access solution in the prior art.

- 25 **[0005]** However in this solution, there are a large number of small cell devices belonging to the different operators in the same area. Furthermore as there are more different operators, there are more related devices, and more overlapping networks are set up, so it is more difficult to deploy the devices. This solution also comes with serious interference between the networks, thus degrading the experiences of the users.

- 30 **[0006]** In another small cell based user access solution in the prior art, a small cell device is shared, that is, the device is invested and set up by one operator, and leased to another operator while providing its own users with a satisfactory service.

- 35 **[0007]** However in this solution, firstly the shared small cell device shall be able to access the core networks of the different operators, so the small cell shall be highly functional; secondly the shared small cell device shall set up Internet Protocol Security (IPSec) tunnels with the security gateway devices of the different operators for the sake of security, and if there are a plurality of such tunnels, then the processing capacity thereof will drop seriously, so that it may not satisfy a normal service usage requirement; thirdly if the users of the operators access the shared small cell device, then the number of small cells deployed in a unit area will increase dramatically, thus making it difficult for the operators to manage and maintain the small cells; and lastly a business mode for sharing and leasing a small cell involves bargaining on and negotiation about a number of items between the operators, so it is difficult to carry out the business mode in practice.

- 40 **[0008]** Apparently in the small cell based user access solutions in the prior art, a small cell can only be accessed by a user of an operator thereof, but cannot be accessed by the users of all the operators; and it is difficult to configure a shared small cell to serve the users of all the operators.

- 45 **[0009]** 3GPP: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Home (e) NodeB; Network aspects (Release 8)" discloses in paragraph 6.2.1.2.3 a proposed method for routing of S1AP messages in HeNB GW with aggregation of S1AP interface instances towards MME. The MME allocates per Ue MME-Ue-S1AP-Id. The HeNB Gateway: a) allocates per Ue eNB-Ue-S1AP-Id for north bound communication and MME-Ue-S1AP-Id for south bound communication; b) creates conversion table for MME-Ue-S1AP-Id-s per UE; c) creates conversion table per Ue for eNB-Ue-S1AP-ID-s per Ue; d) configures the routing of UL and DL messages. The HeNB allocates per Ue eNB-Ue-S1AP-Id.

- 50 **[0010]** PCT Publication WO 2015/061978 A1 relates to a management method and apparatus for network sharing, the method comprising: an access network element obtaining the occupation status of a network sharer in respect of the resources of the access network element; the access network element reporting said status to core network device, said status being used for the core network device to charge UE accessing the access network element.

- 55 **[0011]** "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture description (Release 13)" describes the overall architecture of the E-UTRAN, including internal interfaces and assumptions on the radio, S1 and X2 interfaces.

- [0012]** "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (Release 12)" discloses NAS Transport

Messages in paragraph 9.1.7.

Summary

[0013] Embodiments of the invention provide a method and apparatus for transmitting S1AP signaling so as to address the problem in the prior art that a small cell can only be accessed by a user of an operator thereof, but cannot be accessed by users of respective operators. The invention is set out in the appended set of claims. In the following, parts of the description and drawing referring to embodiments, which are not covered by the claims are not presented as embodiments of the invention, but as examples useful for understanding the invention.

[0014] Particular technical solutions according to the embodiments of the invention are as follows.

[0015] The embodiments of the invention provide a method for transmitting S1AP signaling, the method including: setting up, by a Local Security Gateway, L-Se-GW, deployed on a smart edge device, Internet Protocol Security, IPSec, tunnels with security gateways, Se-GWs, of at least two operators respectively; receiving, by a smart edge device, an SCTP message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell, where the small cell is accessible for terminals of at least two operators; determining, by the smart edge device, an operator network corresponding to the terminal based upon an S1AP ID carried in the uplink S1AP signaling, and transmitting, by the smart edge device, the SCTP message carrying the uplink S1AP signaling to an He-GW of the operator network through an IPSec tunnel between the smart edge device and a security gateway, Se-GW, of the operator network; and receiving, by the smart edge device, an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network through the IPSec tunnel between the smart edge device and the Se-GW of the operator network, determining, by the smart edge device, the small cell corresponding to the terminal based upon an S1AP ID carried in the downlink S1AP signaling, and transmitting, by the smart edge device, the SCTP message carrying the downlink S1AP signaling to the small cell. Determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling includes: obtaining, by the smart edge device, operator information corresponding to the terminal based upon an SCTP message, carrying first uplink S1AP signaling of the terminal, transmitted by the small cell, where the first uplink S1AP signaling carries a first S1AP ID allocated for the terminal by the small cell, and the first S1AP ID carries information about an operator corresponding to the terminal. Determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network includes: creating, by the smart edge device, an S1AP ID mapping relationship according to the first S1AP ID, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship; and determining the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell includes: adjusting, by the smart edge device, the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell.

[0016] Preferably, creating, by the smart edge device, the S1AP ID mapping relationship according to the first S1AP ID, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship includes: allocating, by the smart edge device, a second S1AP ID for the terminal, wherein the second S1AP ID is a unique identifier allocated for the terminal by the smart edge device in the small cell hosted by the smart edge device; creating, by the smart edge device, the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID; and transmitting, by the smart edge device, an SCTP message carrying second uplink S1AP signaling of the terminal to the He-GW of the operator network based upon the S1AP ID mapping relationship and the operator information, wherein the second uplink S1AP signaling carries the second S1AP ID.

[0017] Preferably, adjusting, by the smart edge device, the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell includes: receiving, by the smart edge device, an SCTP message carrying first downlink S1AP signaling of the terminal, wherein the SCTP message carrying the first downlink S1AP signaling is a message returned by the He-GW of the operator network based upon the SCTP message carrying the second uplink S1AP signaling, the first downlink S1AP signaling carries the second S1AP ID and a third S1AP ID, and the third S1AP ID is allocated for the terminal by the He-GW of the operator network; allocating, by the smart edge device, a fourth S1AP ID for the terminal; adjusting, by the smart edge device, the S1AP ID mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID; determining, by the smart edge device, the small cell corresponding to the terminal according to the second S1AP ID; and transmitting, by the smart edge device, an SCTP message carrying second downlink S1AP signaling of the terminal to the small cell based upon the adjusted S1AP ID mapping relationship, wherein the second downlink signaling carries the fourth S1AP ID and the first S1AP ID.

[0018] Preferably, receiving, by the smart edge device, the SCTP message, carrying the uplink S1AP signaling of the

terminal, transmitted by the small cell, determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network includes: receiving, by the smart edge device, the SCTP message, carrying the uplink S1AP signaling including the first S1AP ID and the fourth S1AP ID, transmitted by the small cell; and determining, by the smart edge device, the second S1AP ID and the third S1AP ID based upon the first S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the uplink S1AP signaling including the second S1AP ID and the third S1AP ID to the He-GW of the operator network.

[0019] Preferably, receiving, by the smart edge device, the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, determining the small cell based upon the S1AP ID carried in the downlink S1AP signaling, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell includes: receiving, by the smart edge device, the SCTP message, carrying the downlink S1AP signaling including the second S1AP ID and the third S1AP ID, transmitted by the He-GW of the operator network; and determining, by the smart edge device, the first S1AP ID and the fourth S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling including the first S1AP ID and the fourth S1AP ID to the small cell.

[0020] The embodiments of the invention provide a smart edge device, the smart edge device including: a requesting unit configured to receive an SCTP message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell, to determine an operator network corresponding to the terminal based upon an S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to an He-GW of the operator network through an IPsec tunnel between the smart edge device and an Se-GW of the operator network; and a responding unit configured to receive an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network through an IPsec tunnel between the smart edge device and an Se-GW of the operator network, to determine the small cell corresponding to the terminal based upon an S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell. The small cell is accessible for terminals of at least two operators, and the smart edge device sets up IPsec tunnels with Se-GWs of operator networks of the at least two operators respectively. The requesting unit is further configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling by: obtaining operator information corresponding to the terminal based upon an SCTP message, carrying first uplink S1AP signaling of the terminal, transmitted by the small cell, wherein the first uplink S1AP signaling carries a first S1AP ID allocated for the terminal by the small cell, and the first S1AP ID carries information about an operator corresponding to the terminal. The requesting unit is further configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by: creating an S1AP ID mapping relationship according to the first S1AP ID, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship; and the responding unit is further configured to determine the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: adjusting the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell.

[0021] Preferably, the requesting unit is further configured to create the S1AP ID mapping relationship according to the first S1AP ID, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship by: allocating a second S1AP ID for the terminal, wherein the second S1AP ID is a unique identifier allocated for the terminal by a smart edge device in the small cell hosted by the smart edge device; creating the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID; and transmitting an SCTP message carrying second uplink S1AP signaling of the terminal to the He-GW of the operator network based upon the S1AP ID mapping relationship and the operator information, wherein the second uplink S1AP signaling carries the second S1AP ID.

[0022] Preferably, the requesting unit is further configured to adjust the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, to determine the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: receiving an SCTP message carrying first downlink S1AP signaling of the terminal, wherein the SCTP message carrying the first downlink S1AP signaling is a message returned by the He-GW of the operator network based upon the SCTP message carrying the second uplink S1AP signaling, the first downlink S1AP signaling carries the second S1AP ID and a third S1AP ID, and the third S1AP ID is allocated for the terminal by the He-GW of the operator network; allocating a fourth S1AP ID for the terminal; adjusting the S1AP ID mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID; determining the small cell corresponding to the terminal according to the second S1AP ID; and transmitting an SCTP message carrying second

downlink S1AP signaling of the terminal to the small cell based upon the adjusted S1AP ID mapping relationship, wherein the second downlink signaling carries the fourth S1AP ID and the first S1AP ID.

[0023] Preferably, the requesting unit is further configured to receive the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by: receiving the SCTP message, carrying the uplink S1AP signaling including the first S1AP ID and the fourth S1AP ID, transmitted by the small cell; and determining the second S1AP ID and the third S1AP ID based upon the first S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the uplink S1AP signaling including the second S1AP ID and the third S1AP ID to the He-GW of the operator network.

[0024] Preferably, the responding unit is further configured to receive the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, to determine the small cell based upon the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: receiving the SCTP message, carrying the downlink S1AP signaling including the second S1AP ID and the third S1AP ID, transmitted by the He-GW of the operator network; and determining the first S1AP ID and the fourth S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling including the first S1AP ID and the fourth S1AP ID to the small cell.

[0025] In the embodiments of the invention, the smart edge device receives the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, determines the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmits the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network; and the smart edge device receives the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, determines the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and transmits the SCTP message carrying the downlink S1AP signaling to the small cell. In this way, the small cell can access networks of a plurality of operators to provide terminals of the different operators with a network service.

Brief Description of the Drawings

[0026]

Fig. 1 is a network architectural diagram of small cells in the prior art.

Fig. 2 is a flow chart of transmitting S1AP signaling according to the embodiments of the invention.

Fig. 3 is a network architectural diagram of transmitting S1AP signaling according to the embodiments of the invention.

Fig. 4 is a schematic structural diagram of an apparatus for transmitting S1AP signaling according to the embodiments of the invention.

Detailed Description of the Embodiments

[0027] In order to make the objects, technical solutions, and advantages of the embodiments of the invention more apparent, the technical solutions according to the embodiments of the invention will be described below clearly and fully with reference to the drawings in the embodiments of the invention, and apparently the embodiments to be described are only a part but not all of the embodiments of the invention. Based upon the embodiments here of the invention, all the other embodiments which can occur to those ordinarily skilled in the art without any inventive effort shall fall into the claimed scope of the invention.

[0028] It shall be appreciated that the technical solutions according to the invention can be applicable to various communication systems, e.g., a Global System of Mobile communication (GSM) system, a Code Division Multiple Access (CDMA) system, a Wideband Code Division Multiple Access (WCDMA) system, a General Packet Radio Service (GPRS) system, a Long Term Evolution (LTE) system, an Advanced Long Term Evolution (LTE-A) system, a Universal Mobile Telecommunication System (UMTS) system, etc.

[0029] It shall be further appreciated in the embodiments of the invention, a User Equipment (UE) includes but will not be limited to a Mobile Station (MS), a mobile terminal, a mobile telephone, a handset, a portable equipment, etc., and the user equipment can communicate with one or more core networks over a Radio Access Network (RAN). For example, the user equipment can be a mobile phone (referred to as a "cellular" phone), a computer with a function of radio communication, etc., and the user equipment can also be a portable, pocket, handheld, built-in-computer, or on-vehicle mobile device.

[0030] In the embodiments of the invention, a base station (e.g., an access point) can be such a device in an access network that communicates with a radio terminal over one or more sectors via an air interface. The base station can be configured to convert a received air frame into an IP packet, and a received IP packet into an air frame, and operate as

a router between the radio terminal and the remaining components of the access network, where the remaining components of the access network can include an Internet Protocol (IP) network. The base station can further coordinate attribute management on the air interface, and for example, the base station can be a Base Transceiver Station (BTS) in a GSM or CDMA system, or can be a NodeB in a WCDMA system, or can be an evolved base station (NodeB or eNB or e-NodeB) in an LTE system, although the invention will not be limited thereto.

[0031] In order to address the problem in the prior art that a small cell can only be accessed by a user of an operator thereof, but cannot be accessed by users of respective operators, in the embodiments of the invention, a smart edge device receives a Stream Control Transmission Protocol (SCTP) message, carrying uplink S1 Application Protocol (S1AP) signaling of a terminal, transmitted by a small cell, determines an operator network corresponding to the terminal based upon an S1AP Identifier (ID) carried in the uplink S1AP signaling, and transmits the SCTP message carrying the uplink S1AP signaling to an He-GW of the operator network; and the smart edge device receives an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, determines the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and transmits the SCTP message carrying the downlink S1AP signaling to the small cell.

[0032] Referring to Fig. 2, a particular flow of a method for transmitting S1AP signaling according to the embodiments of the invention is as follows.

[0033] In the operation 200, a small cell transmits an SCTP message carrying first uplink S1AP signaling to a smart edge device.

[0034] In a real application, firstly the small cell allocates a first S1AP ID for a terminal, and adds information about an operator corresponding to the terminal to the first S1AP ID.

[0035] Optionally in this embodiment, the small cell supports all the frequency bands, and supports accesses thereto of terminals of a plurality of operators, and the small cell and the smart edge device allocates an S1AP ID according to agreed principles.

[0036] For example, the S1AP ID includes 28 bits in total as specified in the 3GPP protocol, and for example, accesses of at most eight operators are supported, and terminals of an operator can be identified using three bits.

[0037] Then the small cell transmits the SCTP message carrying the first uplink S1AP signaling of the terminal to the smart edge device, where the first uplink S1AP signaling carries the first S1AP ID.

[0038] In the operation 201, the smart edge device determines an operator network corresponding to the terminal based upon the received SCTP message carrying the first uplink S1AP signaling of the terminal.

[0039] The first S1AP ID carries the operator information, and the smart edge device obtains the operator information corresponding to the terminal based upon the first S1AP ID.

[0040] In the operation 202, the smart edge device creates an S1AP ID mapping relationship based upon the S1AP ID carried in the first uplink S1AP signaling.

[0041] Particularly, the smart edge device obtains the first S1AP ID based upon the S1AP ID carried in the first uplink S1AP signaling, and allocates a second S1AP ID for the terminal, where the second S1AP ID is a unique identifier allocated by the smart edge device for the terminal in the small cell hosted by the smart edge device.

[0042] Then the smart edge device creates the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID to couple the small cell with the smart edge device.

[0043] In the operation 203, the smart edge device transmits an SCTP message carrying second uplink S1AP signaling of the terminal to an He-GW of the operator network based upon the S1AP ID mapping relationship.

[0044] Particularly, firstly the smart edge device obtains the first S1AP ID corresponding to the second S1AP ID based upon the mapping relationship, and obtains the operator information corresponding to the terminal based upon the first S1AP ID; and then the smart edge device transmits the SCTP message carrying the second uplink S1AP signaling of the terminal to the He-GW of the operator network corresponding to the terminal, where the second uplink S1AP signaling carries the second S1AP ID.

[0045] In the operation 204, the smart edge device receives an SCTP message carrying first downlink S1AP signaling of the terminal, and adjusts the S1AP ID mapping relationship based upon an S1AP ID carried in the first downlink S1AP signaling.

[0046] Particularly, firstly the He-GW of the operator network receives the SCTP message carrying the second uplink S1AP signaling of the terminal, and allocates a third S1AP ID for the terminal; and then the He-GW of the operator network transmits the SCTP message carrying the first downlink S1AP signaling of the terminal to the smart edge device, based upon the received SCTP message carrying the second uplink S1AP signaling of the terminal, where the first downlink S1AP signaling carries the second S1AP ID and the third S1AP ID.

[0047] Furthermore, the smart edge device receives the SCTP message carrying the first downlink S1AP signaling of the terminal, and allocates a fourth S1AP ID for the terminal.

[0048] Finally, the smart edge device adjusts the mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID to create a routing relationship between terminals of different operators, and the small cell and the He-GW of the operator network.

[0049] In the operation 205, the smart edge device transmits an SCTP message carrying second downlink S1AP signaling to the small cell based upon the adjusted S1AP ID mapping relationship.

[0050] In a real application, the smart edge device obtain the first S1AP ID corresponding to the second S1AP ID based upon the adjusted S1AP ID mapping relationship, and determines the small cell corresponding to the terminal based upon the first S1AP ID.

[0051] Then, the smart edge device transmits the SCTP message carrying the second downlink S1AP signaling of the terminal to the small cell, where the second downlink S1AP signaling carries the first S1AP ID and the fourth S1AP ID.

[0052] At this point, a routing channel between the small cell and the He-GW of the operator network is laid out according to the adjusted S1AP ID mapping relationship, so that an SCTP message can be transmitted subsequently between the small cell and the He-GW of the operator network.

[0053] A particular process of transmitting an SCTP message subsequently between the small cell and the He-GW of the operator network based upon the mapping relationship will be described below.

[0054] In the operation 300, the smart edge device receives an SCTP message, carrying uplink S1AP signaling of the terminal, transmitted by the small cell.

[0055] Particularly, the small cell transmits the SCTP message, carrying the uplink S1AP signaling of the terminal including a first S1AP ID and a fourth S1AP ID, to the smart edge device.

[0056] Then the smart edge device receives the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, and obtains operator information based upon the first S1AP ID.

[0057] In the operation 301, the smart edge device transmits an SCTP message carrying the uplink S1AP signaling of the terminal to the He-GW of the operator network, based upon the S1AP ID carried in the uplink S1AP signaling and an adjusted mapping relationship.

[0058] Particularly, the smart edge device obtains a second S1AP ID and a third S1AP ID based upon the first S1AP ID and an S1AP ID mapping relationship, and transmits an SCTP message, carrying the uplink S1AP signaling of the terminal including the second S1AP ID and the third S1AP ID, to the He-GW of the operator network.

[0059] For example, the small cell transmits an SCTP message carrying uplink S1AP signaling of a terminal a to an operator A in a real application particularly as follows.

[0060] Firstly, the small cell transmits an SCTP message, carrying uplink S1AP signaling of the terminal a including a first S1AP ID and a fourth S1AP ID, to the smart edge device.

[0061] Then, the smart edge device receives the SCTP message, carrying the uplink S1AP signaling, transmitted by the small cell, and determines an operator corresponding to the terminal a as the operator A based upon the first S1AP ID.

[0062] Finally, the smart edge device determines a second S1AP ID and a third S1AP ID based upon the first S1AP ID and an S1AP ID mapping relationship, and transmits an SCTP message, carrying the uplink S1AP signaling including the second S1AP ID and the third S1AP ID, to an He-GW of a network of the operator A.

[0063] In this way, the small cell transmits the SCTP message of the terminal a to the operator A in a message routing path of: the small cell -> the smart edge device -> an Se-GW of the operator A -> the He-GW of the operator A -> an EPC of the operator A.

[0064] In the operation 302, the smart edge device receives an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network.

[0065] Particularly, the He-GW of the operator network firstly transmits the SCTP message, carrying the downlink S1AP signaling including the second S1AP ID and the third S1AP ID, to the smart edge device.

[0066] Then, the smart edge device receives the SCTP message, carrying the downlink S1AP signaling, transmitted by the He-GW of the operator network.

[0067] In the operation 303, the smart edge device transmits an SCTP message carrying the downlink S1AP signaling to the small cell, based upon the S1AP ID carried in the downlink S1AP signaling and the adjusted mapping relationship.

[0068] Particularly, the smart edge device firstly determines the first S1AP ID, the fourth S1AP ID, and small cell information carried in the first S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship.

[0069] Then, the smart edge device transmits the SCTP message, carrying the downlink S1AP signaling including the first S1AP ID and the fourth S1AP ID, to the small cell.

[0070] For example, the small cell receives an SCTP message, carrying downlink S1AP signaling of the terminal a, returned by the operator A in a real application particularly as follows.

[0071] Firstly, the He-GW of the network of the operator A transmits an SCTP message, carrying the downlink S1AP signaling including the second S1AP ID and the third S1AP ID, to the smart edge device.

[0072] Then, the smart edge device receives the SCTP message, carrying the downlink S1AP signaling, transmitted by the He-GW of the network of the operator A, and obtains the first S1AP ID, the fourth S1AP ID, and the small cell information carried in the first S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship.

[0073] Finally, the smart edge device transmits an SCTP message, carrying the downlink S1AP signaling including the first S1AP ID and the fourth S1AP ID, to the small cell.

[0074] In this way, the small cell receives the SCTP message of the terminal a returned by the operator A in a message

routing path of: the EPC of the operator A -> the He-GW of the operator A -> the Se-GW of the operator A -> the smart edge device -> the small cell.

[0075] The embodiment above will be described below in further details in connection with a particular application scenario.

[0076] For example, the small cell broadcasts system information including an operator B and an operator C. A User Equipment (UE) 1 selects a network of the operator B for an access, and a UE2 selects a network of the operator C for an access. Table 1 depicts an S1AP ID binding relationship stored in the small cell, the smart edge device, and the He-GW.

Table 1: The S1AP ID binding relationship stored in the small cell, the smart edge device, and the He-GW.

	Coupling between the small cell and the smart edge device		Coupling between the smart edge device and the He-GW	
	Small Cell	Smart edge device	Smart edge device	He-GW
UE1	(S1AP ID11, S1AP ID12)	(S1AP ID11, S1AP ID12)	(S1AP ID13, S1AP ID14)	(S1AP ID13, S1AP ID14)
UE2	(S1AP ID21, S1AP ID22)	(S1AP ID21, S1AP ID22)	(S1AP ID23, S1AP ID24)	(S1AP ID23, S1AP ID24)

[0077] Operating flows will be described below taking the UE1 and the UE2 respectively as an example.

1) For an access of the UE1, the small cell allocates an S1AP ID11 for the UE1, the smart edge device allocates an S1AP ID12 for the UE1, the He-GW of the operator B allocates an S1AP ID13 for the UE1, and the smart edge device allocates an S1AP ID14 for the UE1.

[0078] Firstly, the small cell transmits an SCTP message carrying first uplink signaling of the UE1 to the smart edge device, where the first uplink signaling carries the S1AP ID11.

[0079] Then, the smart edge device receives the SCTP message carrying the first uplink signaling of the UE1, and determines an operator corresponding to the UE1 as the operator B based upon operator information in the S1AP ID11.

[0080] Furthermore, the smart edge device creates an S1AP ID mapping relationship based upon the S1AP ID11 and the S1AP ID12, and transmits an SCTP message carrying second uplink S1AP signaling of the UE1 to the He-GW of the network of the operator B based upon the created S1AP ID mapping relationship, where the second uplink S1AP signaling carries the S1AP ID12.

[0081] Then, the He-GW of the network of the operator B receives the SCTP message of the UE1 carrying the second uplink S1AP signaling, and transmits an SCTP message carrying first downlink S1AP signaling to the smart edge device, where the first downlink S1AP signaling carries the S1AP ID12 and the S1AP ID13.

[0082] Furthermore, the smart edge device adjusts the mapping relationship based upon the S1AP ID11, the S1AP ID12, the S1AP ID13, and the S1AP ID14, and determines the small cell corresponding to the UE1 according to the S1AP ID12.

[0083] Then, the smart edge device transmits an SCTP message carrying second downlink S1AP signaling to the small cell based upon the adjusted mapping relationship, where the second downlink S1AP signaling carries the S1AP ID11 and the S1AP ID14.

[0084] At this point, a routing channel between the small cell and the He-GW of the network of the operator B is laid out according to the adjusted S1AP ID mapping relationship so that an SCTP message can be transmitted subsequently between the small cell, and the He-GW of the network of the operator B.

[0085] In this way, the small cell can access networks of a plurality of operators, and provide terminals of the different operators with a network service.

[0086] A particular process of transmitting an SCTP message between the small cell, and the He-GW of the network of the operator B will be described below in detail.

[0087] In order for the small cell to transmit an SCTP message carrying the UE1 to the He-GW of the network of the operator B, the small cell transmits an SCTP message carrying first uplink S1AP signaling of the UE1 to the smart edge device, where the first uplink S1AP signaling carries the S1AP ID11 and the S1AP ID14.

[0088] Then, the smart edge device receives the SCTP message, carrying the first uplink S1AP signaling of the UE1, transmitted by the small cell, and determines the S1AP ID12 and the S1AP ID13 based upon the S1AP ID11 and the adjusted mapping relationship.

[0089] Finally, the smart edge device transmits an SCTP message carrying second uplink S1AP signaling of the UE1 to the He-GW of the network of the operator B, where the second uplink S1AP signaling carries the S1AP ID12 and the

S1AP ID13.

[0090] In order for the small cell to receive an SCTP message, carrying the UE1, returned by the He-GW of the network of the operator B, the He-GW of the network of the operator B firstly transmits an SCTP message carrying first downlink S1AP signaling of the UE1 to the smart edge device, where the first downlink S1AP signaling carries the S1AP ID12 and the S1AP ID13.

[0091] Then, the smart edge device receives the SCTP message, carrying the first downlink S1AP signaling of the UE1, transmitted by the He-GW of the network of the operator B, and determines the S1AP ID11 and the S1AP ID14, based upon the S1AP ID12 carried in the first downlink S1AP signaling and the adjusted mapping relationship.

[0092] Finally, the smart edge device transmits an SCTP message carrying second downlink S1AP signaling of the UE1 to the small cell based upon the adjusted mapping relationship, where the second downlink S1AP signaling carries the S1AP ID11 and the S1AP ID14.

[0093] In this way, the small cell receives the SCTP message returned by the He-GW of the network of the operator B.

[0094] 2) For an access of the UE2, the small cell allocates an S1AP ID21 for the UE2, the smart edge device allocates an S1AP ID22 for the UE2, the He-GW of the operator C allocates an S1AP ID23 for the UE2, and the smart edge device allocates an S1AP ID24 for the UE2.

[0095] Firstly, the small cell transmits an SCTP message carrying first uplink signaling of the UE2 to the smart edge device, where the first uplink signaling carries the S1AP ID21.

[0096] Then, the smart edge device receives the SCTP message carrying the first uplink signaling of the UE2, and determines an operator corresponding to the UE2 as the operator C based upon operator information in the S1AP ID21.

[0097] Furthermore, the smart edge device creates an S1AP ID mapping relationship based upon the S1AP ID21 and the S1AP ID22, and transmits an SCTP message carrying second uplink S1AP signaling of the UE2 to the He-GW of the network of the operator C based upon the S1AP ID mapping relationship, where the second uplink S1AP signaling carries the S1AP ID22.

[0098] Then, the He-GW of the network of the operator C receives the SCTP message of the UE2 carrying the second uplink S1AP signaling, and transmits an SCTP message carrying first downlink S1AP signaling to the smart edge device, where the first downlink S1AP signaling carries the S1AP ID22 and the S1AP ID23.

[0099] Finally, the smart edge device adjusts the mapping relationship based upon the S1AP ID21, the S1AP ID22, the S1AP ID23, and the S1AP ID24, and transmits an SCTP message carrying second downlink S1AP signaling according to the S1AP ID22 and the adjusted mapping relationship, where the second downlink S1AP signaling carries the S1AP ID21 and the S1AP ID24.

[0100] At this point, a routing channel between the small cell and the He-GW of the network of the operator C is laid out according to the adjusted S1AP ID mapping relationship so that an SCTP message can be transmitted subsequently between the small cell, and the He-GW of the network of the operator C.

[0101] In this way, the small cell can access networks of a plurality of operators, and provide terminals of the different operators with a network service.

[0102] A particular process of transmitting an SCTP message between the small cell, and the He-GW of the network of the operator C will be described below in detail.

[0103] In order for the small cell to transmit an SCTP message carrying the UE2 to the He-GW of the network of the operator C, the small cell transmits an SCTP message carrying first uplink S1AP signaling of the UE2 to the smart edge device, where the first uplink S1AP signaling carries the S1AP ID21 and the S1AP ID24.

[0104] Then the smart edge device receives the SCTP message, carrying the first uplink S1AP signaling of the UE2, transmitted by the small cell, and determines the S1AP ID22 and the S1AP ID23 based upon the S1AP ID21 and the adjusted mapping relationship.

[0105] Finally, the smart edge device transmits an SCTP message carrying second uplink S1AP signaling of the UE2 to the He-GW of the network of the operator C, where the second uplink S1AP signaling carries the S1AP ID22 and the S1AP ID23.

[0106] In this way, the small cell transmits the SCTP message to the He-GW of the network of the operator C according to the adjusted mapping relationship.

[0107] In order for the small cell to receive an SCTP message, carrying the UE2, returned by the He-GW of the network of the operator C, the He-GW of the network of the operator C firstly transmits an SCTP message carrying first downlink S1AP signaling of the UE2 to the smart edge device, where the first downlink S1AP signaling carries the S1AP ID22 and the S1AP ID23.

[0108] Then the smart edge device receives the SCTP message, carrying the first downlink S1AP signaling, transmitted by the He-GW of the network of the operator C, and determines the S1AP ID21 and the S1AP ID24 based upon the S1AP ID22 carried in the first downlink S1AP signaling, and the adjusted mapping relationship.

[0109] Finally, the smart edge device transmits an SCTP message carrying second downlink S1AP signaling of the UE2 to the small cell based upon the adjusted mapping relationship, where the second downlink S1AP signaling carries the S1AP ID21 and the S1AP ID24.

[0110] In this way, the small cell receives the SCTP message returned by the He-GW of the network of the operator C according to the adjusted mapping relationship.

[0111] The embodiments above will be described below in further details in connection with a particular application scenario.

[0112] Fig. 3 illustrates a network architectural diagram of transmitting S1AP signaling according to the embodiments of the invention.

[0113] In a real application, a Local Security Gateway (L-Se-GW) is deployed on the smart edge device to provide terminals of a plurality of operators with a network service.

[0114] For example, there are two operators including an operator A and an operator B, and n small cells including a small cell 1, a small cell N, etc., in the embodiments of the invention.

[0115] Here the small cells support all the frequency bands, and support accesses thereto of terminals of the plurality of operators.

[0116] The L-Se-GW of the smart edge device sets up IPsec tunnels with both an Se-GW of the operator A, and an Se-GW of the operator B, where the IPsec tunnels run through transmission networks of respective operators.

[0117] The smart edge device is SCTP-coupled with both an He-GW of the operator A, and an He-GW of the operator B, and messages on the SCTP couplings are borne over the IPsec tunnels. All the Se-GWs of the respective operators allocate for the smart edge device signaling IP addresses for accessing core networks of the respective operators.

[0118] A Local Signaling Gateway (L-S-GW) of the smart edge device is SCTP-coupled with each small cell base station, and the L-S-GW of the smart edge device converges signaling of the base stations, and thereafter transmits the signaling to the core networks of the operators over the IPsec tunnels which are set up between the L-Se-GW of the smart edge device, and the Se-GWs of the respective operators. The L-Se-GW of the smart edge device allocates a signaling IP address for each small cell, where each small cell supports concurrent operating in licensed frequency bands of the operator A and the operator B.

[0119] For uplink transmission, the smart edge device receives an SCTP message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell, and transmits the SCTP message carrying the uplink S1AP signaling to an He-GW of an operator network corresponding to the terminal based upon a first S1AP ID allocated by the small cell, and a mapping relationship; and the smart edge device replaces a source IP address in an IP packet of the SCTP message carrying the uplink S1AP signaling of the terminal with a signaling IP address allocated for the smart edge device by the operator network corresponding to the terminal.

[0120] For downlink transmission, an He-GW of an operator network transmits an SCTP message carrying downlink S1AP signaling of a terminal to the smart edge device based upon a received SCTP message carrying uplink S1AP signaling of the terminal; and the smart edge device determines a first S1AP ID allocated by a small cell based upon a third S1AP ID carried in the downlink S1AP signaling, and a mapping relationship, and since the ID includes information about the small cell, the smart edge device can transmit the SCTP message carrying the downlink S1AP signaling of the terminal to the small cell.

[0121] The smart edge device replaces a destination IP address in an IP packet of the SCTP message carrying the downlink S1AP signaling of the terminal with a signaling IP address of the small cell corresponding to the terminal.

[0122] Based upon the embodiments above, as illustrated in Fig. 4, an apparatus for transmitting S1AP signaling according to the embodiments of the invention particularly includes following components.

[0123] A requesting unit 40 is configured to receive an SCTP message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell, to determine an operator network corresponding to the terminal based upon an S1 Access Point Identifier (S1AP ID) carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to an He-GW of the operator network.

[0124] A responding unit 41 is configured to receive an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, to determine the small cell corresponding to the terminal based upon an S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell.

[0125] Preferably, the requesting unit 40 is configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling by: obtaining operator information corresponding to the terminal based upon an SCTP message, carrying first uplink S1AP signaling of the terminal, transmitted by the small cell, where the first uplink S1AP signaling carries a first S1AP ID allocated for the terminal by the small cell, and the first S1AP ID carries information about an operator corresponding to the terminal.

[0126] Preferably, the requesting unit 40 is configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by: creating an S1AP ID mapping relationship according to the first S1AP ID, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship.

[0127] And the responding unit 41 is configured to determine the small cell corresponding to the terminal based upon

the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: adjusting the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell.

[0128] Preferably, the requesting unit 40 is configured to create the S1AP ID mapping relationship according to the first S1AP ID, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship by: allocating a second S1AP ID for the terminal, where the second S1AP ID is a unique identifier allocated by a smart edge device in the small cell hosted by the smart edge device; creating the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID; and transmitting an SCTP message carrying second uplink S1AP signaling of the terminal to the He-GW of the operator network based upon the S1AP ID mapping relationship and the operator information, where the second uplink S1AP signaling carries the second S1AP ID.

[0129] Preferably, the requesting unit 40 is configured to adjust the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, to determine the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: receiving an SCTP message carrying first downlink S1AP signaling of the terminal, where the SCTP message carrying the first downlink S1AP signaling is a message returned by the He-GW of the operator network based upon the SCTP message carrying the second uplink S1AP signaling, the first downlink S1AP signaling carries the second S1AP ID and a third S1AP ID, and the third S1AP ID is allocated for the terminal by the He-GW of the operator network; allocating a fourth S1AP ID for the terminal; adjusting the mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID; determining the small cell corresponding to the terminal according to the second S1AP ID; and transmitting an SCTP message carrying second downlink S1AP signaling of the terminal to the small cell based upon the adjusted mapping relationship, where the second downlink S1AP signaling carries the fourth S1AP ID and the first S1AP ID.

[0130] Preferably, the requesting unit 40 is configured to receive the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by: receiving the SCTP message, carrying the uplink S1AP signaling including the first S1AP ID and the fourth S1AP ID, transmitted by the small cell; and determining the second S1AP ID and the third S1AP ID based upon the first S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the uplink S1AP signaling including the second S1AP ID and the third S1AP ID to the He-GW of the operator network.

[0131] Preferably, the responding unit 41 is configured to receive the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, to determine the small cell based upon the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by: receiving the SCTP message, carrying the downlink S1AP signaling including the second S1AP ID and the third S1AP ID, transmitted by the He-GW of the operator network; and determining the first S1AP ID and the fourth S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling including the first S1AP ID and the fourth S1AP ID to the small cell.

[0132] In summary, in the embodiments of the invention, the smart edge device receives the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, determines the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmits the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network; and the smart edge device receives the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, determines the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and transmits the SCTP message carrying the downlink S1AP signaling to the small cell. In this way, the small cell can access networks of a plurality of operators to provide terminals of the different operators with a network service.

[0133] Those skilled in the art shall appreciate that the embodiments of the invention can be embodied as a method, a system or a computer program product. Therefore the invention can be embodied in the form of an all-hardware embodiment, an all-software embodiment or an embodiment of software and hardware in combination. Furthermore the invention can be embodied in the form of a computer program product embodied in one or more computer useable storage mediums (including but not limited to a disk memory, a CD-ROM, an optical memory, etc.) in which computer useable program codes are contained.

[0134] The invention has been described in a flow chart and/or a block diagram of the method, the device (system) and the computer program product according to the embodiments of the invention. It shall be appreciated that respective flows and/or blocks in the flow chart and/or the block diagram and combinations of the flows and/or the blocks in the flow chart and/or the block diagram can be embodied in computer program instructions. These computer program instructions can be loaded onto a general-purpose computer, a specific-purpose computer, an embedded processor or

a processor of another programmable data processing device to produce a machine so that the instructions executed on the computer or the processor of the other programmable data processing device create means for performing the functions specified in the flow(s) of the flow chart and/or the block(s) of the block diagram.

[0135] These computer program instructions can also be stored into a computer readable memory capable of directing the computer or the other programmable data processing device to operate in a specific manner so that the instructions stored in the computer readable memory create an article of manufacture including instruction means which perform the functions specified in the flow(s) of the flow chart and/or the block(s) of the block diagram.

[0136] These computer program instructions can also be loaded onto the computer or the other programmable data processing device so that a series of operational operations are performed on the computer or the other programmable data processing device to create a computer implemented process so that the instructions executed on the computer or the other programmable device provide operations for performing the functions specified in the flow(s) of the flow chart and/or the block(s) of the block diagram.

Claims

1. A method for transmitting S1 Application Protocol , S1AP, signaling, comprising:

setting up, by a Local Security Gateway, L-Se-GW, deployed on a smart edge device, Internet Protocol Security, IPsec, tunnels with security gateways, Se-GWs, of at least two operators respectively; receiving, by the smart edge device, a Stream Control Transmission Protocol, SCTP, message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell (300), wherein the small cell is accessible for terminals of the at least two operators; determining, by the smart edge device, an operator network corresponding to the terminal based upon an S1 Access Point Identifier, S1AP ID, carried in the uplink S1AP signaling, and transmitting, by the smart edge device, the SCTP message carrying the uplink S1AP signaling to a signaling gateway, He-GW, of the operator network through an IPsec tunnel between the smart edge device and a security gateway, Se-GW, of the operator network (301); and

receiving, by the smart edge device, an SCTP message, carrying downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network through the IPsec tunnel between the smart edge device and the Se-GW of the operator network (302), determining, by the smart edge device, the small cell corresponding to the terminal based upon an S1AP ID carried in the downlink S1AP signaling, and transmitting, by the smart edge device, the SCTP message carrying the downlink S1AP signaling to the small cell (303);

characterized in that, determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling comprises:

obtaining, by the smart edge device, operator information corresponding to the terminal based upon an SCTP message, carrying first uplink S1AP signaling of the terminal, transmitted by the small cell, wherein the first uplink S1AP signaling carries a first S1AP ID allocated for the terminal by the small cell, and the first S1AP ID carries information about an operator corresponding to the terminal;

wherein determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network (301) comprises:

creating (202), by the smart edge device, an S1AP ID mapping relationship according to the first S1AP ID, and transmitting (203) the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship; and

determining the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell (303) comprises:

adjusting (204), by the smart edge device, the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting (205) the SCTP message carrying the downlink S1AP signaling to the small cell.

2. The method according to claim 1, wherein creating (202), by the smart edge device, the S1AP ID mapping relationship according to the first S1AP ID, and transmitting (203) the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship comprises:

allocating, by the smart edge device, a second S1AP ID for the terminal, wherein the second S1AP ID is a unique identifier allocated for the terminal by the smart edge device in the small cell hosted by the smart edge device;

creating, by the smart edge device, the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID; and

transmitting, by the smart edge device, an SCTP message carrying second uplink S1AP signaling of the terminal to the He-GW of the operator network based upon the S1AP ID mapping relationship and the operator information, wherein the second uplink S1AP signaling carries the second S1AP ID.

3. The method according to claim 2, wherein adjusting (204), by the smart edge device, the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting (205) the SCTP message carrying the downlink S1AP signaling to the small cell comprises:

receiving, by the smart edge device, an SCTP message carrying first downlink S1AP signaling of the terminal, wherein the SCTP message carrying the first downlink S1AP signaling is a message returned by the He-GW of the operator network based upon the SCTP message carrying the second uplink S1AP signaling, the first downlink S1AP signaling carries the second S1AP ID and a third S1AP ID, and the third S1AP ID is allocated for the terminal by the He-GW of the operator network;

allocating, by the smart edge device, a fourth S1AP ID for the terminal;

adjusting, by the smart edge device, the S1AP ID mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID;

determining, by the smart edge device, the small cell corresponding to the terminal according to the second S1AP ID; and

transmitting, by the smart edge device, an SCTP message carrying second downlink S1AP signaling of the terminal to the small cell based upon the adjusted S1AP ID mapping relationship, wherein the second downlink signaling carries the fourth S1AP ID and the first S1AP ID.

4. The method according to claim 3, wherein receiving, by the smart edge device, the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell (300), determining the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network (301) comprises:

receiving, by the smart edge device, the SCTP message, carrying the uplink S1AP signaling comprising the first S1AP ID and the fourth S1AP ID, transmitted by the small cell; and

determining, by the smart edge device, the second S1AP ID and the third S1AP ID based upon the first S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the uplink S1AP signaling comprising the second S1AP ID and the third S1AP ID to the He-GW of the operator network.

5. The method according to claim 3 or 4, wherein receiving, by the smart edge device, the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network (302), determining the small cell based upon the S1AP ID carried in the downlink S1AP signaling, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell (303) comprises:

receiving, by the smart edge device, the SCTP message, carrying the downlink S1AP signaling comprising the second S1AP ID and the third S1AP ID, transmitted by the He-GW of the operator network; and

determining, by the smart edge device, the first S1AP ID and the fourth S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling comprising the first S1AP ID and the fourth S1AP ID to the small cell.

6. A smart edge device, comprising:

a requesting unit (40) configured to receive an SCTP message, carrying uplink S1AP signaling of a terminal, transmitted by a small cell, to determine an operator network corresponding to the terminal based upon an S1 Access Point Identifier, S1AP ID, carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to an He-GW of the operator network through an IPsec tunnel between the smart edge device and an Se-GW of the operator network; and

a responding unit (41) configured to receive an SCTP message, carrying downlink S1AP signaling of the terminal,

transmitted by the He-GW of the operator network through the IPsec tunnel between the smart edge device and the Se-GW of the operator network, to determine the small cell corresponding to the terminal based upon an S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell;

wherein the small cell is accessible for terminals of at least two operators, and a Local Security Gateway, L-Se-GW, deployed on the smart edge device sets up IPsec tunnels with Se-GWs of the at least two operators respectively;

characterized in that, the requesting unit (40) is further configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling by:

obtaining operator information corresponding to the terminal based upon an SCTP message, carrying first uplink S1AP signaling of the terminal, transmitted by the small cell, wherein the first uplink S1AP signaling carries a first S1AP ID allocated for the terminal by the small cell, and the first S1AP ID carries information about an operator corresponding to the terminal;

wherein the requesting unit (40) is further configured to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by:

creating an S1AP ID mapping relationship according to the first S1AP ID, and transmitting the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship; and

the responding unit (41) is further configured to determine the small cell corresponding to the terminal based upon the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by:

adjusting the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, determining the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling to the small cell.

7. The smart edge device according to claim 6, wherein the requesting unit (40) is further configured to create the S1AP ID mapping relationship according to the first S1AP ID, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network based upon the S1AP ID mapping relationship by:

allocating a second S1AP ID for the terminal, wherein the second S1AP ID is a unique identifier allocated for the terminal by a smart edge device in the small cell hosted by the smart edge device;

creating the S1AP ID mapping relationship based upon the first S1AP ID and the second S1AP ID; and transmitting an SCTP message carrying second uplink S1AP signaling of the terminal to the He-GW of the operator network based upon the S1AP ID mapping relationship and the operator information, wherein the second uplink S1AP signaling carries the second S1AP ID.

8. The smart edge device according to claim 7, wherein the requesting unit (40) is further configured to adjust the S1AP ID mapping relationship according to the S1AP ID carried in the downlink S1AP signaling, to determine the small cell corresponding to the terminal based upon the adjusted S1AP ID mapping relationship, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by:

receiving an SCTP message carrying first downlink S1AP signaling of the terminal, wherein the SCTP message carrying the first downlink S1AP signaling is a message returned by the He-GW of the operator network based upon the SCTP message carrying the second uplink S1AP signaling, the first downlink S1AP signaling carries the second S1AP ID and a third S1AP ID, and the third S1AP ID is allocated for the terminal by the He-GW of the operator network;

allocating a fourth S1AP ID for the terminal;

adjusting the S1AP ID mapping relationship based upon the first S1AP ID, the second S1AP ID, the third S1AP ID, and the fourth S1AP ID;

determining the small cell corresponding to the terminal according to the second S1AP ID; and

transmitting an SCTP message carrying second downlink S1AP signaling of the terminal to the small cell based upon the adjusted S1AP ID mapping relationship, wherein the second downlink signaling carries the fourth S1AP ID and the first S1AP ID.

9. The smart edge device according to claim 8, wherein the requesting unit (40) is further configured to receive the SCTP message, carrying the uplink S1AP signaling of the terminal, transmitted by the small cell, to determine the operator network corresponding to the terminal based upon the S1AP ID carried in the uplink S1AP signaling, and to transmit the SCTP message carrying the uplink S1AP signaling to the He-GW of the operator network by:

receiving the SCTP message, carrying the uplink S1AP signaling comprising the first S1AP ID and the fourth S1AP ID, transmitted by the small cell; and
determining the second S1AP ID and the third S1AP ID based upon the first S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the uplink S1AP signaling comprising the second S1AP ID and the third S1AP ID to the He-GW of the operator network.

10. The smart edge device according to claim 8 or 9, wherein the responding unit (41) is further configured to receive the SCTP message, carrying the downlink S1AP signaling of the terminal, transmitted by the He-GW of the operator network, to determine the small cell based upon the S1AP ID carried in the downlink S1AP signaling, and to transmit the SCTP message carrying the downlink S1AP signaling to the small cell by:

receiving the SCTP message, carrying the downlink S1AP signaling comprising the second S1AP ID and the third S1AP ID, transmitted by the He-GW of the operator network; and
determining the first S1AP ID and the fourth S1AP ID based upon the second S1AP ID and the S1AP ID mapping relationship, and transmitting the SCTP message carrying the downlink S1AP signaling comprising the first S1AP ID and the fourth S1AP ID to the small cell.

Patentansprüche

1. Verfahren zur Übertragung von S1-Anwendungsprotokollsignalen (S1AP), das Folgendes umfasst:

Einrichten von Internet Protocol Security, IPSec, Tunneln mit Sicherheits-Gateways, Se-GWs, von mindestens zwei Betreibern durch ein lokales Sicherheits-Gateway, L-Se-GW, das auf einem Smart-Edge-Gerät eingesetzt wird; Empfangen einer Stream Control Transmission Protocol, SCTP, Nachricht durch das Smart-Edge-Gerät, die eine Uplink-S1AP-Signalisierung eines Endgerätes trägt, die von einer kleinen Zelle (300) übertragen wird, wobei die kleine Zelle für Endgeräte der mindestens zwei Betreiber zugänglich ist; Bestimmen, durch das Smart-Edge-Gerät, eines Betreiber-netzes, das dem Endgerät entspricht, basierend auf einer S1-Access-Point-Identifikation, S1AP-ID, die in der Uplink-S1AP-Signalisierung übertragen wird, und Übertragen, durch das Smart-Edge-Gerät, der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an ein Signalisierungs-Gateway, He-GW, des Betreiber-netzes durch einen IPSec-Tunnel zwischen dem Smart-Edge-Gerät und einem Sicherheits-Gateway, Se-GW, des Betreiber-netzes (301); und
Empfangen einer SCTP-Nachricht durch das Smart-Edge-Gerät, die eine Downlink-S1AP-Signalisierung des Endgeräts trägt, die von dem He-GW des Betreiber-netzes durch den IPSec-Tunnel zwischen dem Smart-Edge-Gerät und dem Se-GW des Betreiber-netzes (302) übertragen wird, Bestimmen der kleinen Zelle, die dem Endgerät entspricht, durch das Smart-Edge-Gerät auf der Grundlage einer S1AP-ID, die in der Downlink-S1AP-Signalisierung getragen wird, und Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, durch das Smart-Edge-Gerät an die kleine Zelle (303);

dadurch gekennzeichnet, dass die Bestimmung des Betreiber-netzes, das dem Endgerät entspricht, auf der Grundlage der S1AP-ID, die in der Uplink-S1AP-Signalisierung übertragen wird, umfasst:

Erhalten, durch das Smart-Edge-Gerät, von Betreiberinformationen, die dem Endgerät entsprechen, basierend auf einer SCTP-Nachricht, die eine erste Uplink-S1AP-Signalisierung des Endgeräts trägt, die von der kleinen Zelle übertragen wird, wobei die erste Uplink-S1AP-Signalisierung eine erste S1AP-ID trägt, die dem Endgerät von der kleinen Zelle zugewiesen wird, und die erste S1AP-ID Informationen über einen Betreiber trägt, der dem Endgerät entspricht;
wobei das Bestimmen des Betreiber-netzes, das dem Endgerät entspricht, auf der Grundlage der S1AP-ID, die in der Uplink-S1AP-Signalisierung übertragen wird, und das Übertragen der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an den He-GW des Betreiber-netzes (301) umfasst:

Erzeugen (202), durch das Smart-Edge-Gerät, einer S1AP-ID-Abbildungsbeziehung gemäß der ersten S1AP-ID, und Übertragen (203) der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an den He-GW des Betreiber-netzes auf der Grundlage der S1AP-ID-Abbildungsbeziehung; und

Bestimmen der kleinen Zelle, die dem Endgerät entspricht, auf der Grundlage der S1AP-ID, die in der Downlink-S1AP-Signalisierung übertragen wird, und Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle (303) umfasst:

Anpassen (204) der S1AP-ID-Abbildungsbeziehung durch das Smart-Edge-Gerät gemäß der S1AP-ID, die in der Downlink-S1AP-Signalisierung übertragen wird, Bestimmen der kleinen Zelle, die dem Endgerät entspricht, basierend auf der angepassten S1AP-ID-Abbildungsbeziehung, und Übertragen (205) der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle.

2. Verfahren nach Anspruch 1, wobei das Erzeugen (202) der S1AP-ID-Abbildungsbeziehung gemäß der ersten S1AP-ID durch das Smart-Edge-Gerät und das Übertragen (203) der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an den He-GW des Betreiber-netzes auf der Grundlage der S1AP-ID-Abbildungsbeziehung umfasst:

Zuweisen einer zweiten S1AP-ID für das Endgerät durch das Smart-Edge-Gerät, wobei die zweite S1AP-ID eine eindeutige Kennung ist, die für das Endgerät durch das Smart-Edge-Gerät in der kleinen Zelle, die von dem Smart-Edge-Gerät gehostet wird, zugewiesen wird für das Endgerät durch das Smart-Edge-Gerät in der kleinen Zelle, die von dem Smart-Edge-Gerät gehostet wird;

Erzeugen der S1AP-ID-Abbildungsbeziehung auf der Grundlage der ersten S1AP-ID und der zweiten S1AP-ID durch das Smart-Edge-Gerät; und

Übertragen einer SCTP-Nachricht, die eine zweite Uplink-S1AP-Signalisierung des Endgeräts trägt, durch das Smart-Edge-Gerät an das He-GW des Betreiber-netzes auf der Grundlage der S1AP-ID-Abbildungsbeziehung und der Betreiberinformationen, wobei die zweite Uplink-S1AP-Signalisierung die zweite S1AP-ID trägt.

3. Verfahren nach Anspruch 2, wobei das Anpassen (204) der S1AP-ID-Abbildungsbeziehung durch das Smart-Edge-Gerät gemäß der S1AP-ID, die in der Downlink-S1AP-Signalisierung übertragen wird, das Bestimmen der kleinen Zelle, die dem Endgerät entspricht, auf der Grundlage der angepassten S1AP-ID-Abbildungsbeziehung und das Übertragen (205) der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle umfasst:

Empfangen einer SCTP-Nachricht, die eine erste Downlink-S1AP-Signalisierung des Endgeräts trägt, durch das Smart-Edge-Gerät, wobei die SCTP-Nachricht, die die erste Downlink-S1AP-Signalisierung trägt, eine Nachricht ist, die von dem He-GW des Betreiber-netzes basierend auf der SCTP-Nachricht, die die zweite Uplink-S1AP-Signalisierung trägt, zurückgegeben wird, die erste Downlink-S1AP-Signalisierung die zweite S1AP-ID und eine dritte S1AP-ID trägt und die dritte S1AP-ID für das Endgerät durch das He-GW des Betreiber-netzes zugewiesen wird;

Zuweisung einer vierten S1AP-ID für das Endgerät durch das Smart-Edge-Gerät;

Einstellen der S1AP-ID-Abbildungsbeziehung auf der Grundlage der ersten S1AP-ID, der zweiten S1AP-ID, der dritten S1AP-ID und der vierten S1AP-ID durch das Smart-Edge-Gerät;

Bestimmen der kleinen Zelle, die dem Endgerät entspricht, durch das Smart-Edge-Gerät gemäß der zweiten S1AP-ID; und

Übertragen einer SCTP-Nachricht, die eine zweite Downlink-S1AP-Signalisierung des Endgeräts trägt, durch das Smart-Edge-Gerät an die kleine Zelle auf der Grundlage der angepassten S1AP-ID-Abbildungsbeziehung, wobei die zweite Downlink-Signalisierung die vierte S1AP-ID und die erste S1AP-ID trägt.

4. Verfahren nach Anspruch 3, bei dem das Smart-Edge-Gerät die SCTP-Nachricht empfängt, die die Uplink-S1AP-Signalisierung des Endgeräts trägt, die von der kleinen Zelle (300) übertragen wird, das Betreiber-netz, das dem Endgerät entspricht, auf der Grundlage der S1AP-ID bestimmt, die in der Uplink-S1AP-Signalisierung getragen wird, und die SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an den He-GW des Betreiber-netzes (301) überträgt:

Empfangen der SCTP-Nachricht durch das Smart-Edge-Gerät, die die Uplink-S1AP-Signalisierung trägt, die die erste S1AP-ID und die vierte S1AP-ID umfasst, die von der kleinen Zelle übertragen wurde; und

Bestimmen der zweiten S1AP-ID und der dritten S1AP-ID durch das Smart-Edge-Gerät auf der Grundlage der ersten S1AP-ID und der S1AP-ID-Abbildungsbeziehung, und Übertragen der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung mit der zweiten S1AP-ID und der dritten S1AP-ID enthält, an den He-GW des Betreiber-netzes.

5. Verfahren nach Anspruch 3 oder 4, wobei das Empfangen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung des Endgeräts trägt und von dem He-GW des Betreiber-netzes (302) übertragen wird, durch das Smart-Edge-Gerät, das Bestimmen der kleinen Zelle auf der Grundlage der S1AP-ID, die in der Downlink-S1AP-Signalisierung

getragen wird, und das Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle (303) umfasst:

Empfangen der SCTP-Nachricht durch das Smart-Edge-Gerät, die die Downlink-S1AP-Signalisierung trägt, die die zweite S1AP-ID und die dritte S1AP-ID umfasst, die von dem He-GW des Betreiber-netzes übertragen wurde; und
Bestimmen der ersten S1AP-ID und der vierten S1AP-ID durch das Smart-Edge-Gerät auf der Grundlage der zweiten S1AP-ID und der S1AP-ID-Abbildungsbeziehung, und Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung mit der ersten S1AP-ID und der vierten S1AP-ID enthält, an die kleine Zelle.

6. Smart-Edge-Gerät, das Folgendes umfasst:

eine Anforderungseinheit (40), die so konfiguriert ist, dass sie eine SCTP-Nachricht empfängt, die eine Uplink-S1AP-Signalisierung eines Endgeräts trägt, die von einer kleinen Zelle übertragen wird, um ein Betreiber-netz, das dem Endgerät entspricht, auf der Grundlage eines S1-Zugangspunkt-Identifizierers, S1AP-ID, zu bestimmen, der in der Uplink-S1AP-Signalisierung getragen wird, und um die SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, über einen IPSec-Tunnel zwischen dem Smart-Edge-Gerät und einem Se-GW des Betreiber-netzes an einen He-GW des Betreiber-netzes zu übertragen; und

eine Antworteinheit (41), die so konfiguriert ist, dass sie eine SCTP-Nachricht empfängt, die eine Downlink-S1AP-Signalisierung des Endgeräts trägt, die von dem He-GW des Betreiber-netzes durch den IPSec-Tunnel zwischen dem Smart-Edge-Gerät und dem Se-GW des Betreiber-netzes übertragen wird, um die kleine Zelle, die dem Endgerät entspricht, auf der Grundlage einer S1AP-ID zu bestimmen, die in der Downlink-S1AP-Signalisierung getragen wird, und um die SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle zu übertragen;

wobei die kleine Zelle für Endgeräte von mindestens zwei Betreibern zugänglich ist und ein lokales Sicherheits-Gateway, L-Se-GW, das auf dem Smart-Edge-Gerät eingesetzt wird, IPSec-Tunnel mit Se-GWs der mindestens zwei Betreiber aufbaut;

dadurch gekennzeichnet, dass die Anforderungseinheit (40) ferner so konfiguriert ist, dass sie das dem Endgerät entsprechende Betreiber-netz auf der Grundlage der S1AP-ID bestimmt, die in der Uplink-S1AP-Signalisierung übertragen wird:

Erhalten von Betreiberinformationen, die dem Endgerät entsprechen, basierend auf einer SCTP-Nachricht, die eine erste Uplink-S1AP-Signalisierung des Endgeräts trägt, die von der kleinen Zelle übertragen wird, wobei die erste Uplink-S1AP-Signalisierung eine erste S1AP-ID trägt, die dem Endgerät von der kleinen Zelle zugewiesen wird, und die erste S1AP-ID Informationen über einen Betreiber trägt, der dem Endgerät entspricht;

wobei die Anforderungseinheit (40) ferner so konfiguriert ist, dass sie das dem Endgerät entsprechende Betreiber-netz auf der Grundlage der in der Uplink-S1AP-Signalisierung übertragenen S1AP-ID bestimmt und die SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an den He-GW des Betreiber-netzes überträgt, indem folgende Schritte ausgeführt werden:

Erzeugen einer S1AP-ID-Abbildungsbeziehung gemäß der ersten S1AP-ID und Übertragen der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an das He-GW des Betreiber-netzes auf der Grundlage der S1AP-ID-Abbildungsbeziehung; und

die Antworteinheit (41) ferner so konfiguriert ist, dass sie die kleine Zelle, die dem Endgerät entspricht, auf der Grundlage der S1AP-ID bestimmt, die in der Downlink-S1AP-Signalisierung übertragen wird, und dass sie die SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle überträgt:

Anpassen der S1AP-ID-Abbildungsbeziehung gemäß der S1AP-ID, die in der Downlink-S1AP-Signalisierung übertragen wird, Bestimmen der kleinen Zelle, die dem Endgerät entspricht, auf der Grundlage der angepassten S1AP-ID-Abbildungsbeziehung, und Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle.

7. Smart-Edge-Gerät nach Anspruch 6, wobei die Anforderungseinheit (40) ferner so konfiguriert ist, dass sie die S1AP-ID-Abbildungsbeziehung gemäß der ersten S1AP-ID erstellt und die SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, auf der Grundlage der S1AP-ID-Abbildungsbeziehung an den He-GW des Betreiber-netzes sendet:

Zuweisen einer zweiten S1AP-ID für das Endgerät, wobei die zweite S1AP-ID eine eindeutige Kennung ist, die für das Endgerät von einem Smart-Edge-Gerät in der kleinen Zelle des Smart-Edge-Geräts gehostet wird; Erstellen der S1AP-ID-Abbildungsbeziehung auf der Grundlage der ersten S1AP-ID und der zweiten S1AP-ID; und

Übertragen einer SCTP-Nachricht, die eine zweite Uplink-S1AP-Signalisierung des Endgeräts trägt, an das He-GW des Betreiber-netzes auf der Grundlage der S1AP-ID-Abbildungsbeziehung und der Betreiberinformationen, wobei die zweite Uplink-S1AP-Signalisierung die zweite S1AP-ID trägt.

8. Smart-Edge-Gerät nach Anspruch 7, wobei die Anforderungseinheit (40) ferner so konfiguriert ist, dass sie die S1AP-ID-Abbildungsbeziehung gemäß der in der Downlink-S1AP-Signalisierung übertragenen S1AP-ID anpasst, die dem Endgerät entsprechende kleine Zelle auf der Grundlage der angepassten S1AP-ID-Abbildungsbeziehung bestimmt und die SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle überträgt:

Empfangen einer SCTP-Nachricht, die eine erste Downlink-S1AP-Signalisierung des Endgeräts trägt, wobei die SCTP-Nachricht, die die erste Downlink-S1AP-Signalisierung trägt, eine Nachricht ist, die von dem He-GW des Betreiber-netzes auf der Grundlage der SCTP-Nachricht, die die zweite Uplink-S1AP-Signalisierung trägt, zurückgegeben wird, die erste Downlink-S1AP-Signalisierung die zweite S1AP-ID und eine dritte S1AP-ID trägt und die dritte S1AP-ID für das Endgerät von dem He-GW des Betreiber-netzes zugewiesen wird;

Zuweisung einer vierten S1AP-ID für das Terminal;

Anpassen der S1AP-ID-Abbildungsbeziehung basierend auf der ersten S1AP-ID, der zweiten S1AP-ID, der dritten S1AP-ID und der vierten S1AP-ID;

Bestimmung der kleinen Zelle, die dem Endgerät entspricht, gemäß der zweiten S1AP-ID; und

Übertragen einer SCTP-Nachricht, die eine zweite Downlink-S1AP-Signalisierung des Endgeräts trägt, an die kleine Zelle auf der Grundlage der angepassten S1AP-ID-Abbildungsbeziehung, wobei die zweite Downlink-Signalisierung die vierte S1AP-ID und die erste S1AP-ID trägt.

9. Smart-Edge-Gerät nach Anspruch 8, wobei die Anforderungseinheit (40) ferner so konfiguriert ist, dass sie die SCTP-Nachricht empfängt, die die Uplink-S1AP-Signalisierung des Endgeräts trägt und von der kleinen Zelle übertragen wird, um das dem Endgerät entsprechende Betreiber-netz auf der Grundlage der in der Uplink-S1AP-Signalisierung getragenen S1AP-ID zu bestimmen und die SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, an das He-GW des Betreiber-netzes zu übertragen:

Empfangen der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung trägt, die die erste S1AP-ID und die vierte S1AP-ID umfasst und von der kleinen Zelle übertragen wird; und

Bestimmen der zweiten S1AP-ID und der dritten S1AP-ID auf der Grundlage der ersten S1AP-ID und der S1AP-ID-Abbildungsbeziehung, und Übertragen der SCTP-Nachricht, die die Uplink-S1AP-Signalisierung mit der zweiten S1AP-ID und der dritten S1AP-ID enthält, an den He-GW des Betreiber-netzes.

10. Smart-Edge-Gerät nach Anspruch 8 oder 9, wobei die Antworteinheit (41) ferner so konfiguriert ist, dass sie die SCTP-Nachricht empfängt, die die Downlink-S1AP-Signalisierung des Endgeräts trägt und vom He-GW des Betreiber-netzes übertragen wird, um die kleine Zelle auf der Grundlage der S1AP-ID zu bestimmen, die in der Downlink-S1AP-Signalisierung getragen wird, und um die SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, an die kleine Zelle zu übertragen:

Empfangen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung trägt, die die zweite S1AP-ID und die dritte S1AP-ID umfasst und vom He-GW des Betreiber-netzes übertragen wird; und

Bestimmen der ersten S1AP-ID und der vierten S1AP-ID auf der Grundlage der zweiten S1AP-ID und der S1AP-ID-Abbildungsbeziehung, und Übertragen der SCTP-Nachricht, die die Downlink-S1AP-Signalisierung mit der ersten S1AP-ID und der vierten S1AP-ID enthält, an die kleine Zelle.

Revendications

1. Procédé pour transmettre une signalisation de protocole d'application S1, S1AP, comprenant :

l'établissement, par une passerelle de sécurité locale, L-Se-GW, déployée sur un dispositif périphérique intelligent, de tunnels de sécurité de protocole Internet, IPSec, avec des passerelles de sécurité, Se-GW, d'au moins deux opérateurs respectivement ; la réception, par le dispositif périphérique intelligent, d'un message de pro-

5 tocole de transmission de contrôle de flux, SCTP, transportant une signalisation S1AP de liaison montante d'un terminal, transmise par une petite cellule (300), dans lequel la petite cellule est accessible aux terminaux des au moins deux opérateurs ; déterminer, par le dispositif périphérique intelligent, un réseau de l'opérateur correspondant au terminal sur la base d'un identifiant de point d'accès S1, S1AP ID, transporté dans la signalisation S1AP de liaison montante, et transmettre, par le dispositif périphérique intelligent, le message SCTP transportant la signalisation S1AP de liaison montante à une passerelle de signalisation, He-GW, du réseau de l'opérateur par l'intermédiaire d'un tunnel IPSec entre le dispositif périphérique intelligent et une passerelle de sécurité, Se-GW, du réseau de l'opérateur (301) ; et

10 recevoir, par le dispositif périphérique intelligent, un message SCTP, transportant une signalisation S1AP de liaison descendante du terminal, transmis par le He-GW du réseau de l'opérateur à travers le tunnel IPSec entre le dispositif périphérique intelligent et le Se-GW du réseau de l'opérateur (302), déterminer, par le dispositif périphérique intelligent, la petite cellule correspondant au terminal sur la base d'un ID S1AP transporté dans la signalisation S1AP de liaison descendante, et transmettre, par le dispositif périphérique intelligent, le message SCTP transportant la signalisation S1AP de liaison descendante à la petite cellule (303) ;

15 **caractérisé en ce que** la détermination du réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP transporté dans la signalisation S1AP de liaison montante comprend :

20 obtenir, par le dispositif périphérique intelligent, des informations d'opérateur correspondant au terminal sur la base d'un message SCTP, portant une première signalisation S1AP de liaison montante du terminal, transmise par la petite cellule, dans lequel la première signalisation S1AP de liaison montante porte un premier identifiant S1AP attribué au terminal par la petite cellule, et le premier identifiant S1AP porte des informations sur un opérateur correspondant au terminal ;

25 dans lequel la détermination du réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison montante, et la transmission du message SCTP portant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur (301) comprend :

30 créer (202), par le dispositif périphérique intelligent, une relation de mappage d'ID S1AP selon la première ID S1AP, et transmettre (203) le message SCTP transportant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'ID S1AP ; et déterminer la petite cellule correspondant au terminal sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison descendante, et transmettre le message SCTP portant la signalisation S1AP de liaison descendante à la petite cellule (303) comprend :

35 ajuster (204), par le dispositif périphérique intelligent, la relation de mappage d'ID S1AP selon l'ID S1AP transportée dans la signalisation S1AP de liaison descendante, déterminer la petite cellule correspondant au terminal sur la base de la relation de mappage d'ID S1AP ajustée, et transmettre (205) le message SCTP transportant la signalisation S1AP de liaison descendante à la petite cellule.

2. Procédé selon la revendication 1, dans lequel la création (202), par le dispositif périphérique intelligent, de la relation de mappage d'ID S1AP selon le premier ID S1AP, et la transmission (203) du message SCTP transportant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'ID S1AP comprend :

45 l'attribution, par le dispositif périphérique intelligent, d'un second identifiant S1AP pour le terminal, dans lequel le second identifiant S1AP est un identifiant unique attribué au terminal par le dispositif périphérique intelligent dans la petite cellule hébergée par le dispositif périphérique intelligent ; et pour le terminal par le dispositif périphérique intelligent dans la petite cellule hébergée par le dispositif périphérique intelligent ;

créer, par le dispositif périphérique intelligent, la relation de mappage d'identifiants S1AP sur la base du premier identifiant S1AP et du deuxième identifiant S1AP ; et

50 transmettre, par le dispositif périphérique intelligent, un message SCTP portant une seconde signalisation S1AP de liaison montante du terminal au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'ID S1AP et des informations d'opérateur, dans lequel la seconde signalisation S1AP de liaison montante porte la seconde ID S1AP.

3. Procédé selon la revendication 2, dans lequel l'ajustement (204), par le dispositif de bord intelligent, de la relation de mappage d'ID S1AP selon l'ID S1AP transportée dans la signalisation S1AP de liaison descendante, la détermination de la petite cellule correspondant au terminal sur la base de la relation de mappage d'ID S1AP ajustée, et la transmission (205) du message SCTP transportant la signalisation S1AP de liaison descendante à la petite cellule comprend :

recevoir, par le dispositif périphérique intelligent, un message SCTP portant une première signalisation S1AP de liaison descendante du terminal, dans lequel le message SCTP portant la première signalisation S1AP de liaison descendante est un message renvoyé par le He-GW du réseau opérateur sur la base du message SCTP portant la deuxième signalisation S1AP de liaison montante, la première signalisation S1AP de liaison descendante porte la deuxième ID S1AP et une troisième ID S1AP, et la troisième ID S1AP est attribuée au terminal par le He-GW du réseau opérateur ;

l'attribution, par le dispositif périphérique intelligent, d'un quatrième identifiant S1AP pour le terminal ;

ajuster, par le dispositif périphérique intelligent, la relation de mappage d'identifiants S1AP sur la base du premier identifiant S1AP, du deuxième identifiant S1AP, du troisième identifiant S1AP et du quatrième identifiant S1AP ;

déterminer, par le dispositif de bord intelligent, la petite cellule correspondant au terminal en fonction de la seconde ID S1AP ; et

transmettre, par le dispositif périphérique intelligent, un message SCTP portant une seconde signalisation S1AP de liaison descendante du terminal à la petite cellule sur la base de la relation de mappage d'ID S1AP ajustée, dans lequel la seconde signalisation de liaison descendante porte la quatrième ID S1AP et la première ID S1AP.

4. Procédé selon la revendication 3, dans lequel la réception, par le dispositif périphérique intelligent, du message SCTP, portant la signalisation S1AP de liaison montante du terminal, transmis par la petite cellule (300), la détermination du réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP porté dans la signalisation S1AP de liaison montante, et la transmission du message SCTP portant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur (301) comprend :

recevoir, par le dispositif périphérique intelligent, le message SCTP, portant la signalisation S1AP de liaison montante comprenant le premier identifiant S1AP et le quatrième identifiant S1AP, transmis par la petite cellule ;

et

déterminer, par le dispositif périphérique intelligent, le deuxième identifiant S1AP et le troisième identifiant S1AP sur la base du premier identifiant S1AP et de la relation de mappage d'identifiants S1AP, et transmettre le message SCTP portant la signalisation S1AP de liaison montante comprenant le deuxième identifiant S1AP et le troisième identifiant S1AP à la station He-GW du réseau de l'opérateur.

5. Procédé selon la revendication 3 ou 4, dans lequel la réception, par le dispositif périphérique intelligent, du message SCTP, portant la signalisation S1AP de liaison descendante du terminal, transmis par le He-GW du réseau de l'opérateur (302), la détermination de la petite cellule sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison descendante, et la transmission du message SCTP portant la signalisation S1AP de liaison descendante à la petite cellule (303) comprend :

recevoir, par le dispositif périphérique intelligent, le message SCTP, portant la signalisation S1AP de liaison descendante comprenant le deuxième identifiant S1AP et le troisième identifiant S1AP, transmis par le He-GW du réseau de l'opérateur ; et

déterminer, par le dispositif périphérique intelligent, le premier identifiant S1AP et le quatrième identifiant S1AP sur la base du deuxième identifiant S1AP et de la relation de mappage d'identifiant S1AP, et transmettre le message SCTP portant la signalisation S1AP de liaison descendante comprenant le premier identifiant S1AP et le quatrième identifiant S1AP à la petite cellule.

6. Un dispositif de bord intelligent, comprenant :

une unité de demande (40) configurée pour recevoir un message SCTP, transportant une signalisation S1AP de liaison montante d'un terminal, transmis par une petite cellule, pour déterminer un réseau de l'opérateur correspondant au terminal sur la base d'un identifiant de point d'accès S1, S1AP ID, transporté dans la signalisation S1AP de liaison montante, et pour transmettre le message SCTP transportant la signalisation S1AP de liaison montante à un He-GW du réseau de l'opérateur par le biais d'un tunnel IPSec entre le dispositif de périphérie intelligente et un Se-GW du réseau de l'opérateur ; et

une unité de réponse (41) configurée pour recevoir un message SCTP, transportant une signalisation S1AP de liaison descendante du terminal, transmis par le He-GW du réseau de l'opérateur par le biais du tunnel IPSec entre le dispositif de bord intelligent et le Se-GW du réseau de l'opérateur, pour déterminer la petite cellule correspondant au terminal sur la base d'un ID S1AP transporté dans la signalisation S1AP de liaison descendante, et pour transmettre le message SCTP transportant la signalisation S1AP de liaison descendante à la petite cellule ;

dans lequel la petite cellule est accessible aux terminaux d'au moins deux opérateurs, et une passerelle de sécurité locale, L-Se-GW, déployée sur le dispositif périphérique intelligent établit des tunnels IPSec avec les Se-GW des au moins deux opérateurs respectivement ;

caractérisé en ce que, l'unité de demande (40) est en outre configurée pour déterminer le réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP transporté dans la signalisation S1AP de liaison montante par :

obtenir des informations d'opérateur correspondant au terminal sur la base d'un message SCTP, portant une première signalisation S1AP de liaison montante du terminal, transmise par la petite cellule, dans lequel la première signalisation S1AP de liaison montante porte un premier ID S1AP attribué au terminal par la petite cellule, et le premier ID S1AP porte des informations sur un opérateur correspondant au terminal ;

dans lequel l'unité de demande (40) est en outre configurée pour déterminer le réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison montante, et pour transmettre le message SCTP portant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur par :

créer une relation de mappage d'identifiant S1AP selon le premier identifiant S1AP, et transmettre le message SCTP transportant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'identifiant S1AP ; et

l'unité de réponse (41) est en outre configurée pour déterminer la petite cellule correspondant au terminal sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison descendante, et pour transmettre le message SCTP portant la signalisation S1AP de liaison descendante à la petite cellule par :

ajuster la relation de mappage d'ID S1AP en fonction de l'ID S1AP transportée dans la signalisation S1AP de liaison descendante, déterminer la petite cellule correspondant au terminal sur la base de la relation de mappage d'ID S1AP ajustée, et transmettre le message SCTP transportant la signalisation S1AP de liaison descendante à la petite cellule.

7. Dispositif périphérique intelligent selon la revendication 6, dans lequel l'unité de demande (40) est en outre configurée pour créer la relation de mappage d'ID S1AP selon le premier ID S1AP, et pour transmettre le message SCTP portant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'ID S1AP par :

attribuer un deuxième identifiant S1AP au terminal, le deuxième identifiant S1AP étant un identifiant unique attribué au terminal par un dispositif de bord intelligent dans la petite cellule hébergée par le dispositif de bord intelligent ; et pour le terminal par un dispositif périphérique intelligent dans la petite cellule hébergée par le dispositif périphérique intelligent ;

créer la relation de mappage des identifiants S1AP sur la base du premier identifiant S1AP et du deuxième identifiant S1AP ; et

transmettre un message SCTP portant une deuxième signalisation S1AP de liaison montante du terminal au He-GW du réseau de l'opérateur sur la base de la relation de mappage d'ID S1AP et des informations d'opérateur, dans lequel la deuxième signalisation S1AP de liaison montante porte la deuxième ID S1AP.

8. Dispositif périphérique intelligent selon la revendication 7, dans lequel l'unité de demande (40) est en outre configurée pour ajuster la relation de mappage d'ID S1AP selon l'ID S1AP portée dans la signalisation S1AP de liaison descendante, pour déterminer la petite cellule correspondant au terminal sur la base de la relation de mappage d'ID S1AP ajustée, et pour transmettre le message SCTP portant la signalisation S1AP de liaison descendante à la petite cellule par :

recevoir un message SCTP portant une première signalisation S1AP de liaison descendante du terminal, dans lequel le message SCTP portant la première signalisation S1AP de liaison descendante est un message renvoyé par le He-GW du réseau opérateur sur la base du message SCTP portant la deuxième signalisation S1AP de liaison montante, la première signalisation S1AP de liaison descendante porte la deuxième ID S1AP et une troisième ID S1AP, et la troisième ID S1AP est attribuée au terminal par le He-GW du réseau opérateur ;

l'attribution d'un quatrième identifiant S1AP pour le terminal ;

ajuster la relation de mappage des identifiants S1AP sur la base du premier identifiant S1AP, du deuxième identifiant S1AP, du troisième identifiant S1AP et du quatrième identifiant S1AP ;

déterminer la petite cellule correspondant au terminal en fonction de la deuxième ID S1AP ; et transmettre un message SCTP portant une deuxième signalisation S1AP de liaison descendante du terminal à la petite cellule sur la base de la relation de mappage d'ID S1AP ajustée, dans lequel la deuxième signalisation de liaison descendante porte la quatrième ID S1AP et la première ID S1AP.

5

9. Dispositif périphérique intelligent selon la revendication 8, dans lequel l'unité de demande (40) est en outre configurée pour recevoir le message SCTP, portant la signalisation S1AP de liaison montante du terminal, transmis par la petite cellule, pour déterminer le réseau de l'opérateur correspondant au terminal sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison montante, et pour transmettre le message SCTP portant la signalisation S1AP de liaison montante au He-GW du réseau de l'opérateur par :

10

recevoir le message SCTP, portant la signalisation S1AP de liaison montante comprenant le premier identifiant S1AP et le quatrième identifiant S1AP, transmis par la petite cellule ; et déterminer le deuxième identifiant S1AP et le troisième identifiant S1AP sur la base du premier identifiant S1AP et de la relation de mappage d'identifiants S1AP, et transmettre le message SCTP portant la signalisation S1AP de liaison montante comprenant le deuxième identifiant S1AP et le troisième identifiant S1AP à l'unité He-GW du réseau de l'opérateur.

15

10. Dispositif périphérique intelligent selon la revendication 8 ou 9, dans lequel l'unité de réponse (41) est en outre configurée pour recevoir le message SCTP, portant la signalisation S1AP de liaison descendante du terminal, transmis par le He-GW du réseau de l'opérateur, pour déterminer la petite cellule sur la base de l'ID S1AP portée dans la signalisation S1AP de liaison descendante, et pour transmettre le message SCTP portant la signalisation S1AP de liaison descendante à la petite cellule par :

20

recevoir le message SCTP, portant la signalisation S1AP de liaison descendante comprenant le deuxième identifiant S1AP et le troisième identifiant S1AP, transmis par le He-GW du réseau de l'opérateur ; et déterminer le premier identifiant S1AP et le quatrième identifiant S1AP sur la base du deuxième identifiant S1AP et de la relation de mappage d'identifiants S1AP, et transmettre le message SCTP portant la signalisation S1AP de liaison descendante comprenant le premier identifiant S1AP et le quatrième identifiant S1AP à la petite cellule.

25

30

35

40

45

50

55

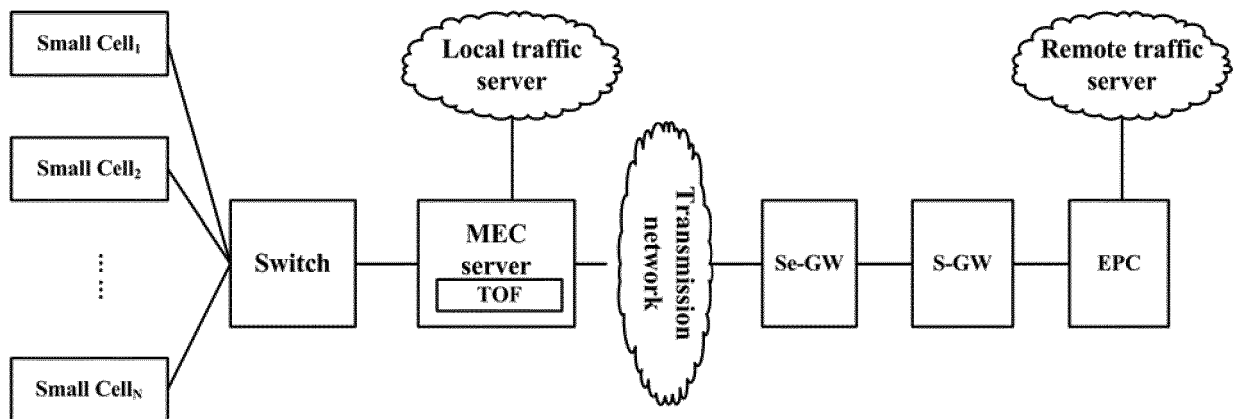


Fig. 1

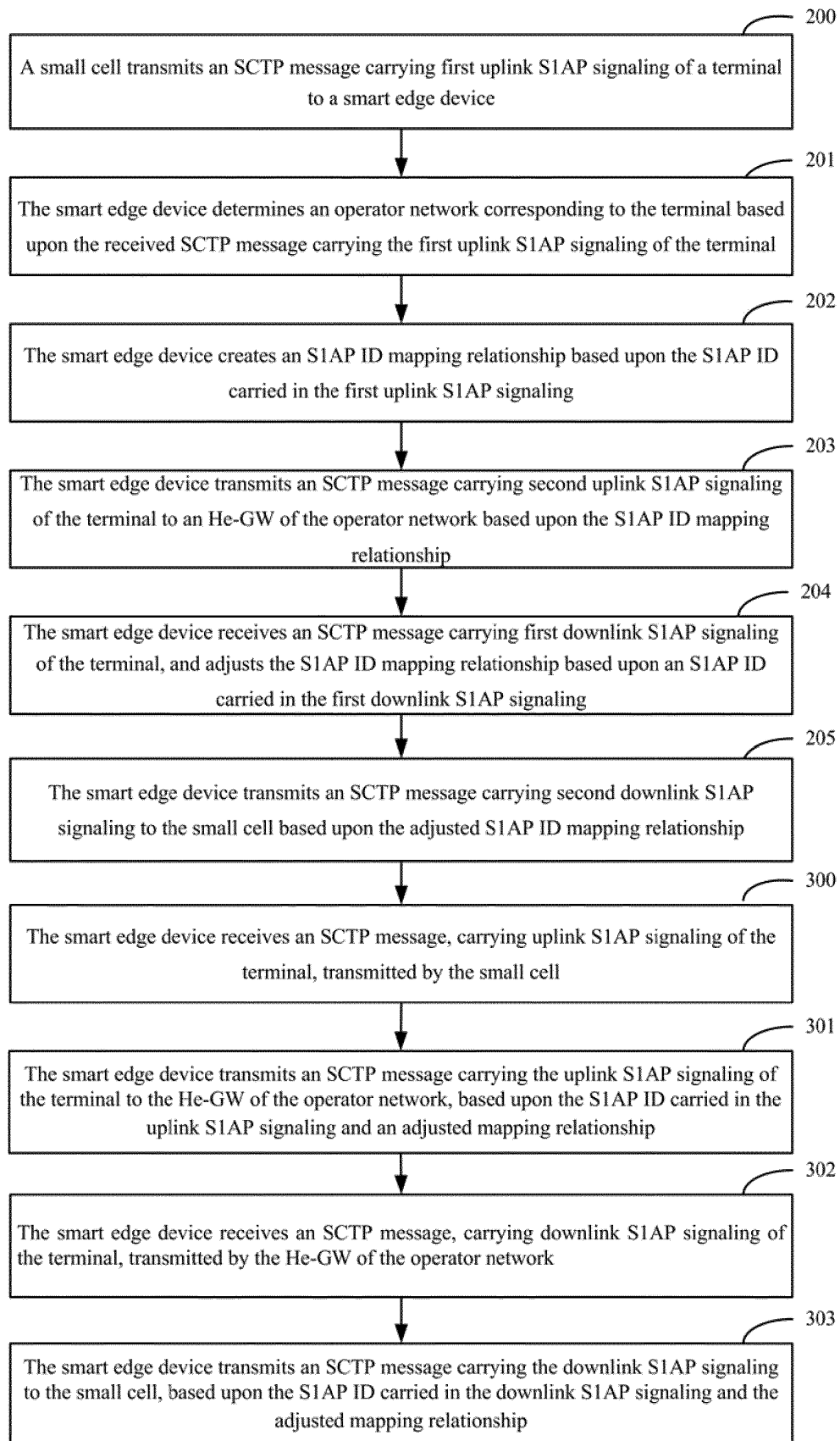


Fig. 2

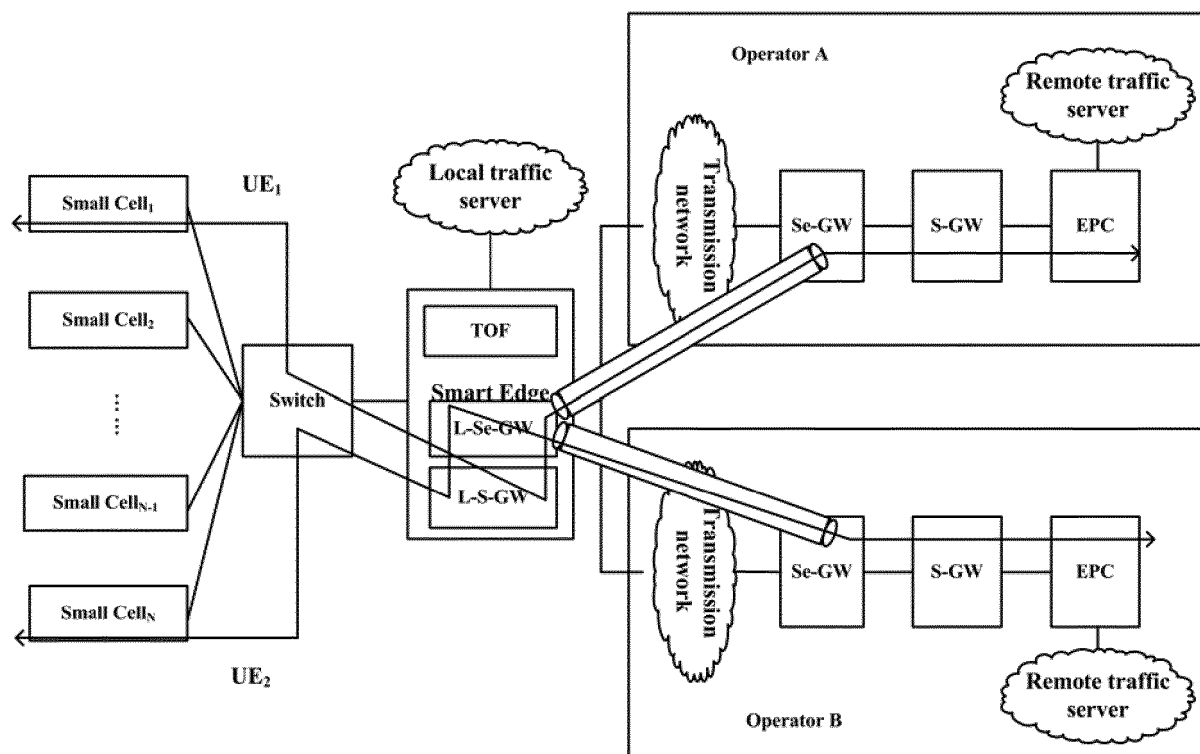


Fig. 3

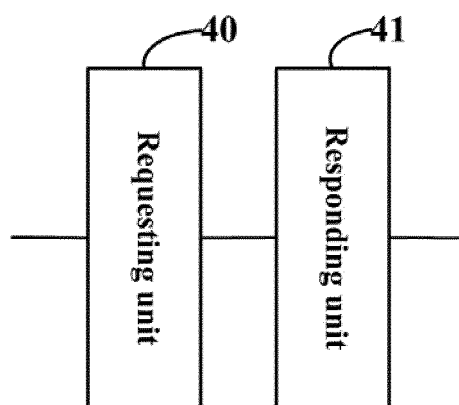


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2015061978 A1 [0010]